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Diamond-VeNOM: a high-speed slope profiler for characterising X-ray mirrors

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We present the Diamond-VeNOM (velocity-NOM): a high-speed slope profiler of X-ray optics. With recent improvements in the fabrication quality of X-ray mirrors, the systematic errors of optical profilers are no longer negligible. For optics with slope errors $\ll 100$ nrad rms, repeated scans with the mirror oriented in a range of configurations are required to null experimental errors and improve measurement accuracy. This process is effective, but time consuming. To solve this problem, we have developed a dynamic profilometer system, whereby the optical surface is pitched in synchronization with translation of the scan head. Multiple autocollimators are used to simultaneously monitor the optical surface, parasitic angular errors of the air-bearing scan head, and angular rotation of the optic under test. A significant increase in measurement speed is achieved using new Elcomat5000 autocollimators with a 250 Hz acquisition rate. Based on 1 kHz feedback from motion encoders, a PandA input/output box triggers mechanical shutters to simultaneously block the beam path of each autocollimator when the motion stages reach a series of user-defined positions or angles. This enables synchronization of variable-speed translation and pitch trajectories with data acquisition from multiple autocollimators. This new innovation reduces the burden of post-processing data alignment and enables more sophisticated motion trajectories, including on-the-fly, automated nulling of the optical surface to reduce systematic errors. We demonstrate that fly-scanning, combined with the speed enhancement of the new autocollimators, leads to a 20X time efficiency of the Diamond-VeNOM compared to the Diamond-NOM's traditional step-scans, without loss of data quality.

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yes

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